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FOR THE NORTH-AMERICAN JOURNAL.

Spots on the Sun.

There is no occasion for surprise, and still less for alarm, on account of the spots, which have lately appeared on the sun. Similar ones have often been observed before. It is true, that they are not often large enough to be perceived by the naked eye. But they may almost always be seen by the half of a telescope, and it is much more uncommon to find the sun without them, than with them. The moon also, has spots; the bodies of the planets are not of a uniform brightness. Many of the fixed stars are subject to an alternate increase and diminution of light. Our own sky is sometimes bright and sometimes obscured by clouds. The whole face of nature is variable, every thing is mutable and fluctuating. Nothing is constant but change. The wonder is, that the sun should pour forth so uniform and steady a light, not that it should sometimes be partially interrupted.

The sun's spots have now been observed and speculated upon, for more than two hundred years. There is nothing like regularity in their form and appearance. They are as various in magnitude, and as diversified in figure, as the clouds of our atmosphere, and some of them as fleeting. Sometimes, twenty, thirty, and even fifty may be seen at once, sometimes, none are to be found for a number of years. They have been known to occupy an extent, equal to a fifth of the sun's diameter in length, and a twentieth in breadth.

Some spots are darker, and others brighter than the rest of the disk. They are often found to succeed each other alternately in the same place. The dark spot consists generally, of two parts, a centre and a border, or nucleus and umbra as they are called. The centre is of a darker shade than the border, and the border is darkest towards its outer edge, and is distinguished from the deeper coloured nucleus, by a well defined and very marked difference of light. But, a circumstance of the utmost importance, as indicating the nature of these spots, is, that they are all in motion, and all move with the same rapidity, and in the

same direction, and if they continue long enough, they all return in nearly the same time. They are about fourteen days in passing over the sun, from east to west apparently, and in the same time, reappear again in the east. Few remain long enough to make an entire revolution. One has been observed during nearly three complete periods. It appears also, that these spots, at particular seasons of the year, move over the sun in straight lines, at all other times, in lines more or less curved, and the paths described by different spots, observed at the same time, are always parallel to each other, and always have their curvature and position determined by the season.

These few facts, will enable us to judge of the value of most of the hypotheses, that have been proposed respecting the nature of the phenomena in question.

If our lakes, Superiour, Ontario, Erie, &c. were visible to a spectator at the sun, they would exhibit an appearance very similiar to that which the solar spots do to us. They would not appear to pass over the centre of the earth's disk. They would all move across in the same time. They would describe straight lines, when our days and nights are equal, about the middle of March and middle of September. At all other times, their paths would be curved, and most so, at the time of our longest and shortest days. Besides, they would appear broadest when near the middle point of their passage, and at their entering and going off, they would be contracted in breadth, their length in the direction parallel to the sun's limb being undiminished.

We conclude, therefore, from the facts that have been stated, that the sun's spots adhere to his surface, and that their motion is produced by the motion of the sun upon an axis not quite perpendicular to the ecliptick. They cannot be Mercury or Venus, for these planets are only a few hours in passing over the sun, and they always appear round and move in apparently straight lines. They cannot consist of a collection of small planets nearer the sun, for similar reasons. Their motion is too slow, and they ought not to be so long between us and the sun, as they are in describing the rest of their orbits. If half of the orbit described, is comprehended within the sun's breadth, it is a sufficient proof that it coincides with his surface. Their dilating and contracting also, according as they are near the

centre or border, seem to be a natural consequence of such a coincidence. This circumstance, moreover, seems not very favourable to the supposition, that these appearances proceed from elevated objects, as mountains or rocks, rising above the luminous matter of the sun. We should expect, were this the case, that they would exhibit a greater breadth and more of a triangular form, when viewed in a direction perpendicular to their basis, and that we should have the same spot return, after a certain interval of time, presenting the same appearance, and occupying the same place. But, nothing of this kind is to be found in the history of these appearances.

There was a remarkable spot in 1769, which appeared to be depressed below the surface of the sun. As it approached the limb, the umbra, or shadowy margin, nearest the centre of the sun disappeared first. On its return to the other limb, the other margin, being nearest the centre, was invisible. It was hid apparently by the intervening portion of the sun's body. As the spot advanced upon the disk, it came into view. Dr. Herschell has observed many appearances of this kind, and is fully persuaded, that these dark specks are below the surface of the sun. He has given views and observations which tend very much to confirm this opinion. He has undertaken to measure the sides of the depression, and to determine its depth. He thinks that the phenomena of the spots arise, not from excavations in the body of the sun, but, from openings in his atmosphere; that the solid substance of the sun is opaque, like the planets, and that like the planets, it is surrounded by an atmosphere, that this atmosphere is transparent to the height of about two thousand miles, and gives support at this elevation to a stratum of dark clouds, on which, as the outer substance of the sun, rests the flood of luminous matter, which presents itself to the surrounding planets. This light is supposed to be produced by the combustion of gasses, which are generated below, and which in their ascent drive away the clouds and billows of flame, that float upon them, and thus give us a glimpse both of the opaque surface of the sun and of the cloudy stratum above it, and that these form the nucleus and umbra of a spot; our earth probably presents similar appearances to the inhabitants of the moon. Where it is covered with clouds, it will exhibit a uniform brightness,

where there are breaks and interruptions, the naked body of the earth will be seen, of a darker shade on account of these clouds, which intercept much of the light. The sides of the opening also would present themselves alternately, as the earth revolved on its axis, by which means, their depth might be ascertained, as Dr. Herschell ascertained the depth of the openings in the solar clouds.

The sun's spots then, according to this hypothesis, are chasms in his atmosphere, occasioned by ascending currents of gaseous fuel, and they are succeeded by faculæ, as they are called, or bright spots on account of this additional supply of combustible matter, which, it may be supposed, is most completely on fire soon after the opening has closed. But how is the sun ordinarily furnished when there are no spots? The gas may be more diffused, and by ascending in smaller quantities, may produce no sensible disturbance of the luminous fluid. Besides, there are probably openings, that are too small to be seen, and the sun may never be free from them. It is only when their absolute magnitude is very great, that they become an object of any attention.

Dr. Herschell has observed, that the luminous matter of the sun, when viewed with his best telescopes, is far from preserving always the same aspect. It is sometimes, even and tranquil, and sometimes it is thrown up into ridges and appears to be agitated, like the sea in a storm. The changes, when in this state, are often very rapid, small openings are formed and closed in a few minutes, and clouds are seen passing with a rapidity, that considerably alters their situation in the course of an hour. These fluctuations are *more particularly observed* during the time of large and frequent spots. Hence Dr. Herschell infers, that there is a variable emission of light and heat, intimately connected with the appearance and disappearance of spots, and that seasons of uncommon heat and cold, of fertility and barrenness, so far as they depend upon the supply of heat, are to be traced not so much to accidental causes near at hand, as to the inconstancy of the fountain. We are like plants in a green house that are healthy and vigorous, or chilled with the frost, according as the flues are well or ill attended to. We depend for the very means of subsistence, as well as for all the comforts of climate, upon operations, that are going on ninety millions of miles off, upon the more

or less rapid compositions and decompositions, that are taking place in this great laboratory of nature.

There was nothing remarkable in the spot which lately appeared, but its magnitude. Its form, appearance and motion, were just as they should be, and just like a thousand others that have appeared before, in strict conformity to analogy, as well as to the constitution of the sun. But because it happened to be larger than usual, every body begins to wonder at it and to guess about it, as a thing that never occurred before. Beside the large spot, which consisted of several distinct nuclei and umbræ, there was a number of small spots to be seen at the same time, by the help of a telescope. These have passed off and new ones have come on. The return of the large spot has not been recognized. The alterations that it underwent, while visible, render it very doubtful whether it retained its identity long enough to reappear.

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Lee's Observations on Light.

A paper was read before the Royal Society of London in June, 1815, on the dispersive power of the atmosphere and its effects on astronomical observations. It was presented by Stephen Lee, Clerk and Librarian to the Royal Society. It contains some very interesting remarks and observations upon a phenomenon, which has been almost entirely overlooked, and which appears to have an important influence upon the apparent places of the heavenly bodies. Every one knows, that when a beam of light passes obliquely from one medium to another, the different rays are refracted unequally, some are deflected more, and others less, from a rectilineal direction. The several rays, constituting the different colours, are thus separated from each other, the red being least refracted, and the violet most. But no allowance has been made for this difference of refrangibility, notwithstanding the difference of colour among the heavenly bodies, and the differently coloured glasses that are used in looking at the sun and moon. When the sun's altitude for instance, is taken with a sextant, a glass, that is tinged with some colour, is used to protect the eye. But different